IES Newsletter

Volume 7, Number 4
July – August 1990

Director's Note

Thirty-six students and scientists from numerous states, from Puerto Rico, from Chile and from the People's Republic of China are doing independent research and assisting IES ecologists with research projects this summer. In addition, a number of local individuals have been hired by IES administrators, horticulturists and grounds crew to help with the day-to-day operation of the Institute during this fast paced — and fast growing — summer season.

Nine students selected to participate in the Research Experiences for Undergraduates Program are working on their own research projects under the guidance of IES mentor scientists. The second John S. Eaton Fellow is collecting and analyzing data during rainstorms, as part of her Ph.D. research. A biology professor who has played a major role in establishing modern ecological science in Chile is collaborating with our ecologists. High school and college students are gaining experience and furthering their education by working as summer assistants in our laboratories and administrative offices, in the perennial garden and greenhouse. Some of the work being done by these individuals will be discussed in this issue, and in the September-October issue of the IES Newsletter.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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REU Program: Third Year for NSF-Supported Student Research at IES

High on the list of priorities at the Institute of Ecosystem Studies is education. For this reason, the Institute has developed a curriculum for elementary school ecology education, has greatly expanded its Continuing Education Program, and has developed ways in which college students can work with IES ecologists to learn techniques of scientific research while at the same time making real contributions to the body of scientific knowledge.

For three years the Institute has had help with the latter from the National Science Foundation (NSF) by means of its Research Experiences for Undergraduates (REU) Program. One goal of the National Science Foundation is to stimulate and support interest in the sciences, and an effective way to achieve this goal is to provide opportunities for college students to participate in research. This year, out of just over 100 applications for support in the field of biological and behavioral sciences, thirty-four awards were made. The Institute received one of these grants: funding to make it possible for nine undergraduate students to do three months of research with the guidance of an IES mentor scientist.

To give the REU students as broad an exposure to science as possible, the Institute schedules "Research Strategies" lectures to discuss methods for doing research, interpreting results and communicating findings; and "Research in Context" seminars to bring ecology into the public arena. At the IES "Forum on Opportunities in Ecology," students met with professionals who use their ecological background in a range of research and non-research careers. Finally, on August 20, the students are presenting their findings to the IES community and to the public. (Call 677-5358 for information on this symposium.) The students' papers describing 1990 research and results will be compiled as an IES Occasional Publication.

Summaries of the work by three of the REU students follow.

ELIZABETH E. CRONE, College of William and Mary, Williamsburg, Virginia. Mentor: Dr. Clive G. Jones.

Photosynthesis, a chemical reaction that requires sunlight to convert atmospheric carbon dioxide to carbohydrates, occurs in plants' leaves. Phenol-glycosides are defensive chemicals found in some plants. These chemical compounds, which protect the plants from pathogens and pests, are built from carbon fixed by the leaves during photosynthesis. Shade reduces photosynthesis, and this "stress" may then result in less carbon being available to make phenol-glycosides. Ms. Crone is studying how shade alters the chemistry of cottonwood tree leaves; her hypothesis is that the leaves grown under shaded conditions will taste better to some insect pests due to the reduced phenol-glycoside concentrations. Her results have implications to Dr. Jones' ongoing studies of the effects of air pollution (e.g., ozone) on plant resistance to pests, since high levels of ozone reduce photosynthesis, decrease phenol-glycosides and result in increased feeding by some insects.

Using feeding preference of the introduced willow leaf beetle as an indicator of phenol-glycoside levels, Ms. Crone is comparing the palatability of leaves from young cottonwood trees that have been grown at high-light versus low-light levels. Leaf disks from experimental plants and control plants will be put in small plastic "arenas" with beetles collected from local willow trees, and preferences will be determined by measuring the consumption rates.

MICHELE F. PINCKNEY, Johnson C. Smith College, Charlotte, N.C. Mentor: Dr. Clive G. Jones.

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TOM TAFT

In the Greenhouse, Dr. Jones meets with Michele Pinckney about her cottonwood study.

Rainstorm Field Work for Eaton Fellow

What invisible changes occur in the East Branch of Wappinger Creek — the stream that flows through the Arboretum — during a rainstorm? Do different types of rainstorms bring different changes? Xiaoying Ma immerses herself — literally — in the creek during summer downpours to try to learn the answers to these questions.

Xiaoying Ma is enrolled in a Ph.D. program in environmental science and water quality at the State University of New York (SUNY) College of Environmental Science and Forestry (ESF) in Syracuse. She hopes to earn her doctorate by the latter part of 1992. She will return, then, to Beijing Normal University in the People's Republic of China where she received her bachelor's and master's degrees and where a position in water quality assessment awaits her.

Ms. Ma's research and educational goals are to become familiar with the most modern types of analytical equipment for studying water chemistry and to learn current techniques for water quality modeling. How is water quality modeling used? She explains: Suppose farmers living 100 kilometers downstream from a city want to irrigate their crops with river water. The city is a "point source" for pollution, so environmental managers need to determine what the water quality will be at the irrigation site. Knowing the flow rate of the river and the amount of sewage released at the point source, they can apply existing mathematical models to estimate the pollutant levels at the site in question. Ms. Ma's Ph.D. dissertation will concern the application of water quality modeling to China.

Ms. Ma, recipient of the second John S. Eaton Fellowship in Laboratory Sciences, began three months of IES research early in May. (The work of Alexandra Shultz, the first Eaton Fellow, was described in the May–June 1990 issue of the IES NEWSLETTER.) Ms. Ma's goals here are to study the relationship between water quality and rainfall — what is the impact of storm events on the East Branch of Wappinger Creek? — and to gain practical experience as she uses analytical equipment in the Institute's chemistry laboratories.

Her field work is done at the stream monitoring station near the Fern Glen. (At this station, temperature and water level are measured continuously for IES long-term studies.) Hourly during each rainstorm, until the water level reaches its peak, Ms. Ma pulls on hip boots and wades in. At three sites in the stream she measures dissolved oxygen levels and takes water level and velocity measurements, then scoops up 250 milliliters (9 ounces) of streamwater for chemical analysis. Back at the IES laboratories she measures the amount of particulate matter, determines the pH (the degree of acidity/alkalinity of the water) and analyzes the samples for chemicals, including nitrate, sulfate, calcium and phosphorus. Once the level of the creek starts to drop, it can take several days for it to reach its "normal" height. During this time, the chemistry of the streamwater changes slowly, and representative samples can be taken at longer intervals.

TOM TAFT

Xaioying Ma, hip boots on, collects data in the East Branch of Wappinger Creek.

Preliminary results show that while the concentration of some chemicals in streamwater decreases as the flow increases, that of others — such as phosphorus that is washed into the creek from surrounding soils — increases. Ms. Ma will complete the laboratory analyses before she leaves IES and will present her results in September at the qualifying examination required of Ph.D. students at SUNY-ESF. A copy of her findings will be available at the Institute.

REU Program, *from page 1*

Ms. Pinckney is also using imported willow leaf beetles in her study, and is focusing on the insects' reactions to cottonwood tree leaves that have been exposed to ambient doses of ozone . . . concentrations such as those that may be found in the Hudson Valley on hot summer days. Willow leaf beetles will normally use cottonwood leaves both as a surface for egg-laying and as a food source, as indicated above. Studies have shown, however, that the beetles are less inclined to lay their eggs on, and more inclined to feed on, cottonwood leaves that have been exposed to ozone. Ms. Pinckney will be investigating the possible chemical mechanisms responsible for these changes.

Her first experiment tests the hypothesis that the decrease in oviposition, or egg-laying, is due to a volatile chemical in cottonwood leaves that acts as a repellent and is released when the plants have been exposed to ozone. Her second experiment will see how changes in phenol-glycoside concentrations influence the feeding preferences of beetles. As described in the summary of Elizabeth Crone's study, ozone reduces phenol-glycoside concentrations and increases beetle feeding. Ms. Pinckney plans to examine the relationship between phenol-glycoside levels and feeding by painting different concentrations of these chemicals onto leaves.

MAYRA TORO, Interamerican University of Puerto Rico, San German, Puerto Rico. Mentors: Drs. Margaret M. Carreiro and Steward T. A. Pickett.

It is commonly known that fallen leaves are the home of microorganisms that decay organic matter. It is not so commonly known that these microorganisms — bacteria and microscopic fungi (filamentous fungi and yeast) — also live on healthy leaves that are still on the tree. There is some evidence to suggest that, there, they may help the host plants to fight disease.

Because fungi are sensitive to environmental factors such as temperature, humidity and air pollutants, Ms. Toro's scientific hypothesis is that fungal development will be lower in urban areas than in rural areas. Her focus is on yeast and filamentous fungi, and her REU study deals with these organisms on leaves taken from red oak trees in three environments: The New York Botanical Garden (urban area), Westchester County, N.Y. (suburban area), and Litchfield County, Conn. (rural area). Using agar as a growth medium, she is culturing microfungi from small disks cut out of each leaf, and when colonies grow she will separate each different species onto fresh agar. Once the organisms have been isolated, she will determine their diversity and their frequency and in this way learn if there is any kind of pattern within and between the three areas.

Phosphorus . . . Sulfate . . . Acid Rain: Dr. Caraco Investigates Possible Link

Phosphorus is required for plant and animal life due to its roles in the storage and supply of energy in the cell and as a component of DNA, the genetic material of all cells. A major source of naturally-occurring phosphorus is rocks, and through their weathering the mineral is freed into soil or aquatic ecosystems where it is absorbed by green plants. In this way phosphorus enters the food web as a vital nutrient.

When freshwater ecosystems receive exceptionally high inputs of phosphorus, algae — simple aquatic plants — take advantage of the additional nutrients and multiply rapidly. This rapid increase can disturb the balance of the system and result in a process called eutrophication. Dense and unsightly algal blooms develop; these may, at times, be toxic to animals. When the algae die, sink to the bottom and decay, their decomposition consumes oxygen. The decomposition of large amounts of this plant material can lead to complete oxygen depletion in bottom waters and sometimes in the entire water column, making the once healthy ecosystem uninhabitable for fish and other organisms.

MICHAEL JOHN

Dr. Caraco uses her canoe to sample lakes for phosphorus and sulfate.

For four years, IES biogeochemist Dr. Nina Caraco has been analyzing the phosphorus budget of Mirror Lake, near the Hubbard Brook Experimental Forest in New Hampshire's White Mountains, in research supported by grants from the National Science Foundation (NSF) and the Andrew Mellon Foundation. She was interested in finding out what happens to the phosphorus in algae after the plants die and sink to the bottom sediments. In many lakes, most of the phosphorus stays in the sediments. In other lakes, however, the sediments act as a continuous source of phosphorus to the water above, and previous research has suggested that this is most apt to happen when the lake's bottom waters are anoxic — having very low levels of oxygen. Mirror Lake has anoxic bottom waters and should therefore have a high level of phosphorus release, with gradual eutrophication a possible consequence. Surprisingly, however, the lake has a very low level of phosphorus release, and Dr. Caraco wanted to discover why.

Dr. Caraco's investigations of this question led her to discover that concentrations of sulfate — a form of sulfur — were major determinants of whether or not phosphorus was released from sediments: high levels of sulfate led to high levels of phosphorus release, and those lakes with a low sulfate content — like Mirror Lake — did not release phosphorus. This suggested a link to acid rain. Sulfur dioxide gas discharged from smokestacks is one of the two major contributors to acid precipitation. Thus, when acid precipitation leads to acidification of a lake, it also adds sulfur. While the acidifying effect of acid rain has received a great deal of study, Dr. Caraco's work suggests that the sulfate pollution has its own, previously unexpected effect: an increase in phosphorus release from lake sediments, with eutrophication a possible result. This means that even so-called "insensitive lakes" — those in which the acid from acid rain is largely neutralized by naturally occurring buffers — are sensitive to excess sulfur deposition.

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Dr. Likens Receives Awards

Twice during the past several months, Institute of Ecosystem Studies Director Dr. Gene E. Likens has been honored for his pioneering research and for his contributions to society.

At the 151st annual commencement at Miami University (Oxford, Ohio), Dr. Likens was awarded an honorary doctor of science degree. In conferring the degree, University President Dr. Paul G. Pearson cited Dr. Likens' prolific and innovative research, his role as counsel on ecological issues to the nation's leaders, and his work as an educator and advocate of strong science programs for American youth. Dr. Pearson also said that Dr. Likens teaches "with a voice that reaches us all," and earlier during the ceremonies Dr. Likens had done just that. As commencement speaker, he urged graduates to become environmental activists as "unsalaried staff members of the Environmental Protection Agency, getting involved where we live, joining local planning boards, zoning boards, conservation commissions, being informed, running for office, speaking out, writing letters to legislators, opposing needless destruction of natural resources and minimizing waste."

Miami University photo

Dr. Gene E. Likens was awarded an honorary degree at the Miami University commencement exercises. L. to r.: Graduate Dean Leonard Simutis, Dr. Likens and President Paul G. Pearson.

Dr. Likens is also the recipient of the 1990 AIBS Distinguished Service Award. In making this award, the American Institute of Biological Sciences (AIBS), a national organization supporting research and education in all the biological sciences and the application of these disciplines to human welfare, cited Dr. Likens' dedication to seeking solutions to complex environmental problems. In the July/August 1990 issue of BioScience, the AIBS journal, the award announcement described Dr. Likens' achievement:

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Caraco, *from page 3*

Dr. Caraco, Dr. Likens and IES aquatic microbiologist Dr. Jonathan Cole have recently received a new NSF grant to investigate the sulfate/phosphorus-release theory in lakes in other parts of the country and to try to discover what it is about sulfate that affects release of phosphorus. This summer, sampling will be done in lakes of New York's Catskill Mountains, New Hampshire, Connecticut, Pennsylvania, Florida, Wisconsin and the upper peninsula of Michigan.

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In February 1990 Dr. Nina Caraco was promoted to research associate at the Institute of Ecosystem Studies. She began her research at IES in February 1986 as a postdoctoral associate, after receiving a Ph.D. in marine ecology and biology from Boston University.

Likens, *from page 3*

(He) has been a proponent of long-term ecological research as a way to solve global ecological problems. Using long-term studies, he was the first to document the impact of acid rain on terrestrial systems in the United States. He has also looked at ways deforestation affects water quality and flow rate . . . . His expertise has been tapped by governments and private organizations around the world.

The 1990 AIBS Distinguished Service Award is being presented to Dr. Likens on August 5 during the AIBS annual meeting in Richmond, Virginia.

Summer/Fall Calendar

CONTINUING EDUCATION PROGRAM

The **fall semester** begins on September 16, with certificate classes, short-courses, workshops, ecological excursions and holiday decoration workshops being offered through mid-December. If you are not on our mailing list, please call to request a catalogue, or pick up a copy at the Gifford House.

SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of each month, except over holiday weekends. Programs begin at 2 p.m. at the Gifford House on Route 44A unless otherwise noted. For walks, dress according to the weather, with long pants, socks and sturdy footwear.
Call (914) 677-5359 to confirm the day's topic.

August 19: **The IES Air Pollution Garden**, a demonstration led by IES educator Melissa Hayes
September 16: Call the number below to learn if a program has been scheduled for this date.
October 21: **Getting to Know Native Plants for Naturalistic Landscaping**, a walk led by Dr. Mark McDonnell

In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the day's program.

IES SEMINARS

The Institute's program of **scientific seminars** features presentations by visiting scientists or Institute staff. All seminars are held in the Plant Science Building on Fridays at 3:30 p.m. Free.

Sept. 14: Title to be announced.
Speaker: Dr. Barry Hart, Chisholm Institute of Technology, Australia.
Sept. 21: **The Intersection Between Ecology and Evolution**, by Dr. Niles Eldredge, American Museum of Natural History.
Sept. 28: **Direct and Indirect Influences of Subterranean Mammalian Herbivores on Overlying Plants and Plant Communities**, by Dr. O.J. Reichman, Ecology Program Director, National Science Foundation.
Oct. 5: Topic: **Vegetational History of the Adirondacks**, by Dr. Stephen T. Jackson, Brown University and Northern Arizona University
Oct. 12: Title to be announced.
Speaker: Dr. Leonard Smock, Virginia Commonwealth Univ.
Oct. 19: **Spatial Scaling and Nitrogen Sources and Sinks in Stream Ecosystems**.
Speaker: Dr. Nancy Grimm, Arizona State Univ.
Oct. 26: Topic: **Snowshoe Hare Population Cycles**, by Dr. Charles J. Krebs, Univ. of British Columbia

GREENHOUSE

The IES greenhouse is a year-round tropical plant paradise as well as a site for controlled environmental research. There is no admission fee, but visitors should first stop at the Gifford House for a free permit.

GIFT SHOP

Senior Citizens Days: On Wednesdays senior citizens receive a 10% discount on all purchases (except sale items).
Fall bulbs will be available after Labor Day.

ARBORETUM HOURS
(Summer Hours: May 1 – September 30; closed on public holidays)

The **Arboretum** grounds are open Monday through Saturday, 9 a.m. to 6 p.m.; Sunday 1 – 6 p.m.
The Greenhouse and the Plant Science Building close at 4 p.m.
The **Gift and Plant Shop** is open Tuesday through Saturday 11 a.m. to 5 p.m. and Sunday 1 – 5 p.m. (closed weekdays from 1 – 1:30 p.m.).

Note: Winter hours begin October 1. Please call the number below for information.

All visitors must obtain a free permit at the Gifford House for access to the Arboretum. Permits are available up to one hour before closing time.

For more information, call (914) 677-5359 weekdays from 8:30 - 4:30.

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